

Article XV.—ON THE NAMES OF LOWER EOCENE FAUNAL HORIZONS OF WYOMING AND NEW MEXICO.

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The writer has been engaged for the past five years in the exploration, for the American Museum, of the Lower Eocene of Wyoming and New Mexico. A large collection of fossil mammals has been brought together, and important stratigraphic studies have been made, principally by Dr. Wm. J. Sinclair who has accompanied three of the expeditions. A systematic study of the collection, now well under way, by Dr. W. D. Matthew, Dr. Sinclair, and the writer, has shown the existence of a greater number of distinct faunal horizons in these regions than was previously known to have existed. Some of these horizons have already been defined and named by Sinclair and Granger in two articles in this Bulletin¹ and the object of the present article is to make certain corrections and to establish four new horizon names, two for the Bighorn region and two for New Mexico. Geographical names are used because they are the most satisfactory. The use of generic names for the purpose of defining mammal horizons often leads to confusion and, except in conjunction with geographic names, should be discontinued. For instance, the name *Coryphodon Zone* has been used for a certain horizon of the Bighorn deposits, yet the genus occurs in more or less abundance throughout the entire Lower Eocene. In some cases horizons can be, and are, determined by the range of a certain genus but there are other horizons which possess no characteristic genus, or at least none common enough to serve the purpose of defining and outlining the zone. The possibility of a generic name being relegated to synonymy is another argument against its use for this purpose.²

WYOMING.

Previous to 1904 the mammal-bearing Tertiary of the Bighorn basin was considered as one formation and one faunal horizon. Collections from upper 15 Mile Creek, an area known as Buffalo basin, seemed to represent

¹ Bull. Amer. Mus. Nat. Hist., Vol. XXX, 1911, art. vii; Vol. XXXI, 1912, art. v.

² Note.— Geologic levels can no longer be correlated merely by generic names, we are subdividing the strata so finely. They can still be distinguished by generic and specific names. The day will probably come when trinomials will be necessary. Abandonment of faunal names for the Life Zones would be a step backward. H. F. O.

a somewhat younger fauna than that from the Gray Bull valley but still it lacked all of the characteristic forms of the later Wind River fauna. In 1904 Dr. F. B. Loomis, of Amherst College, conducted explorations in the Bighorn basin and succeeded in obtaining specimens of the Wind River genus *Lambdotherium* from the upper levels at the western end of Tatman Mountain, and he concluded from that that the upper 1000 feet of the Bighorn sediments overlapped in time the base of the Wind River.¹

The work of the American Museum expeditions in the Wind River basin in 1905, 1909 and 1910 resulted in the discovery that there were two very distinct Lower Eocene faunal horizons there and they were given separate names by Sinclair and Granger.² The upper beds containing *Lambdotherium* and *Eotitanops* were named the Lost Cabin formation and the lower beds, from which these two genera were absent, the Lysite formation. The Wind River collection of Cope and of the early expeditions from this museum were all from the upper horizon and the name "Wind River" as previously used, with reference to the fauna, is equivalent to Lost Cabin.

Continuing work in the Bighorn basin in 1910 and 1911 the American Museum party made a considerable collection in the *Lambdotherium* level of Dr. Loomis, sufficient to establish beyond much doubt that this horizon is the exact equivalent of a portion, at least, of the Lost Cabin. The thickness of these beds in the Bighorn basin is 325 feet and in the type locality about 400 feet.

Below the Lost Cabin beds of the Bighorn basin are some 500 feet of deposits which were referred to the Lysite. The principal exposures of the series of strata are in the upper part of Buffalo basin to the south of Tatman Mountain and along the northern base of the Mountain in the Gray Bull Valley, between Fenton and Coyote Canon. A large collection has been obtained from these beds and the analysis of the fauna shows that the reference to the Lysite was a correct one.

Lying exposed along the Gray Bull River between the base of the Lysite and what has been mapped by Fisher as "Laramie and associated formations," probably in part Fort Union, is another series of 600 feet or more of highly fossiliferous beds. The beds are exposed chiefly along the south side of the river from a little above Fenton to just below the mouth of Dorsey Creek and are most extensive in the vicinity of Otto. This is the horizon and locality of the larger part of the Lower Eocene collections from the Bighorn basin including the two *Phenacodus* skeletons of the Cope collection and the *Coryphodon*, *Oxyæna*, and *Eohippus* skeletons of later

¹ Am. Jour. Sci., XXIII, 1907, p. 363.

² Loc. cit., 1911, p. 104.

collecting. Lithologically, the beds cannot be separated from the overlying Lysite but the faunal distinctions are sufficient to warrant such a separation. It is the horizon of the genus *Systemodon*, one of the commonest forms, and marks the limits of this genus. In the Lysite *Systemodon* is replaced by *Heptodon*. It was the presence or absence of these genera which determined in the field the line of separation between the Lysite and the underlying beds.

As mentioned above the name Wasatch has been commonly used for the whole series of mammal-bearing beds of this basin. The name was originally used by Hayden for a group of formations in the vicinity of Evanston in southwestern Wyoming, the uppermost of which, and the only one containing mammals, has been designated by Veatch the Knight formation. The known fauna of the typical Knight beds is a very small one and the material is very fragmentary. The types of Cope have been either too fragmentary or too uncharacteristic to be of much value for accurate correlation. A small collection obtained by the writer from the type locality in 1906 does, however, contain some characteristic forms and a recent examination of this material shows that the fauna is more nearly that of the Lysite than of any other Bighorn horizon. The genus *Heptodon* is present and the species of *Hyopsodus* and *Cynodontomys* are Lysite species. The beds lying below the Lysite in the Bighorn basin were referred by Sinclair and Granger to the Knight but it now seems that a new name is needed to distinguish this most important Lower Eocene faunal horizon and the name **Gray Bull** beds is proposed.

Besides the exposures along the Gray Bull River these beds are found to the southward on all but the upper parts of Elk, 5 Mile, and 10 Mile Creeks, and east of the Bighorn River near Worland. To the north of the Gray Bull they outcrop along Dry and Coon Creeks and are exposed extensively about the eastern and northern base of McCulloch Peak. In the Clark Fork basin they are exposed in the southwestern part along the heads of Big and Little Sand Coulees, where they are of a uniform gray color instead of the usual gray, red and yellowish banding.

The party of 1911 obtained from low-lying gray shales at the southwestern base of McCulloch Peak and also from the vicinity of the low divide between the Clark Fork and Bighorn basins north of Ralston a small collection of mammals which appeared to represent a fauna distinctly different from that of the *Systemodon* beds, and in the McCulloch Peak locality there appeared to be an angular unconformity between this horizon and the beds with *Systemodon*. It was suggested by Sinclair and Granger that if, when the fauna became better known, it were deemed advisable to give these lower beds a distinct name they might be called the Ralston

beds or Ralston formation.¹ In 1912 the writer with the assistance of Mr. Wm. Stein made a careful search of these beds in the Clark Fork basin and in the Bighorn basin along the bluff which lies a few miles north of Ralston and Powell, and still further collecting was done in this region last season by Messrs. Stein and P. L. Turner. The fossils obtained, representing nearly 200 individuals, demonstrated clearly that this horizon is a very distinct one, older than the Gray Bull and perhaps representing the top of the Paleocene Series. Unfortunately the name "Ralston" is preoccupied² and the name **Clark Fork** beds is substituted. The Clark Fork beds are exposed principally in the Clark Fork basin and in the adjoining part of the Bighorn basin along the bluff lying north of Ralston and Powell, also at the southwestern base of McCulloch Peak. The maximum thickness of the beds is at least 500 feet and they rest upon beds whose age is not positively determined, perhaps Cretaceous, perhaps Fort Union. Whether or not there is an unconformity at this point the writer is unable to say. The beds are sparingly fossiliferous throughout the area examined. In the bluff in the northern part of the Bighorn basin characteristic fossils were found as far east as a point north of Powell. In the Clark Fork basin the fossils were obtained from both sides of the wagon road where it drops down to Big Sand Coulee from the Bighorn basin divide, also from the extensive area between Big and Little Sand Coulees and from the opposite side of Clark Fork River between the mouths of Line and Little Rocky Creeks.

The Clark Fork fauna is characterized by the absence of Perissodactyls, Artiodactyls, Rodents, and Primates, and by the predominance of Phenacodonts of the genera *Phenacodus* and *Ectocion*, specimens of these two genera constituting three-fourths of the collection obtained. The Amblypoda are represented by *Coryphodon* and a primitive form of *Bathyopsis*. Creodonts of several Lower Eocene genera are present and the species in most cases are more primitive than the Gray Bull species. The genus *Esthonyx* is fairly common but the two species are distinct from Gray Bull species. So far as known the mammalian fauna does not include any Torrejon or Fort Union³ genera not found in the overlying Gray Bull beds but it does include many Gray Bull genera which do not extend down to the Torrejon or Fort Union. However, the reptilian genus *Champsosaurus* is not uncommon and this is distinctly a Cretaceous and Paleocene form. This with the absence of the four orders of mammals mentioned above,

¹ *Loc.cit.*, 1912, p. 60.

² *Ralston Group*, a division of the Pennsylvania Series, Gould, Ohern and Hutchison. State Univ. of Oklahoma, Research Bulletin, No. 3, 1910, p. 13.

³ By Fort Union is meant the fauna from Sweetgrass County, Montana, as described by Douglass and Gidley.

which is the most important feature of the fauna, favor the placing of these beds as Paleocene rather than Lower Eocene.

Near the head of Big Sand Coulee in the Clark Fork basin there is a series of about 200 feet of red-banded shales lying between the gray shales of the Clark Fork and the *Systemodon*-bearing gray shales above which are referred to the Gray Bull beds. The outcrop of these red-banded beds extended, from the high bluff on the south side of the Coulee, in a northwesterly direction across the basin for several miles. The dip is to the southwest and the beds appear to be conformable with the overlying strata. There may be an angular unconformity between this series and the underlying Clark Fork beds, but it is not evident without the aid of instruments. This horizon does not contain *Systemodon* but it does contain the Perissodactyl genus *Eohippus* in abundance as well as Artiodactyls, Rodents and Primates, and marks the first appearance of these four orders. It also marks the last appearance of the primitive order Multituberculata which is represented in this horizon by a genus of Plagiaulacids. The fauna is radically different from the Clark Fork. From the Gray Bull it differs in the absence of *Systemodon*, in the presence of the Plagiaulacid, and in the generally more primitive character of such genera as are common to both horizons. Altogether the fauna is sufficiently distinct to be separately designated and the name **Sand Coulee** beds is proposed for the horizon. Besides the outcrop mentioned above this horizon is exposed for a small area on the point of the bluff, about four miles northeast of Ralston, and again on the south bank of Clark Fork River, just above the mouth of Pat O'Hara Creek. It is possible that it occurs further to the south, also, along the Shoshone River, but its presence there has not been noted.

NEW MEXICO.

The thickness of the Wasatch beds of northwestern New Mexico has been estimated at about 1000 feet and mammalian fossils occur throughout the greater part of the vertical range. The beds have much the same general appearance of those of the Wasatch group in the Bighorn basin, red, gray, and ochraceous bands of shales and sandstones, and there is no evident unconformity throughout the series. Cope who first explored the region for fossils obtained a collection comprising some twenty genera of mammals but the levels of these specimens, many of which are generic types, has not been known, although an examination of Cope's field notebook in which the specimens collected each day were rather carefully recorded affords a clue to the level of some of them. In 1912 the writer and Mr.

Stein covered pretty thoroughly nearly all of the fossil-bearing portions of those beds, which lie in the neighborhood of Gallina, Ojo San José, and La Hara, and a fairly good representative collection was secured. The fauna as a whole presents a rather different facies from that of the Bighorn Wasatch. Particularly to be noted in this connection is the absence in New Mexico beds of all Perissodactyls, with the exception of *Eohippus*, which is very abundant. This difference in fauna, which is probably to be accounted for by the wide geographical separation of the locality, makes it advisable, it seems, to use distinct horizon names for the New Mexico beds. The fauna falls into two divisions, the upper one, characterized by the Condylarth genus *Meniscotherium*, resembling the Lost Cabin fauna in general,¹ and the lower one with characters of both the Lysite and Gray Bull. The lower horizon, comprising roughly the lower two-thirds of the New Mexico Wasatch, may be referred to as the **Almagre** beds and the upper horizon, comprising the remaining third, the **Largo** beds. The division between the two horizons as indicated by the first appearance of *Meniscotherium* is found about fifty feet above the low divide which separates the headwaters of Largo Cañon and the southwest branch of Almagre Arroyo, about five miles northwest of Ojo San José. The Almagre beds are exposed over the greater part of the Almagre watershed and also at the head of the Arroyo Blanco, this latter locality being the first of the great "horseshoes" mentioned by Cope in his description of the country. The Largo beds are exposed principally in the area drained by the head of Largo Arroyo, in the high bluff just west of Ojo San José, and in all except the base of the second great "horseshoe" of Cope which is southwest of Ojo San José and which is drained by a tributary of the Puerco River. The upper beds are similar in appearance to the lower except that the red strata are more dominant, a condition which is noted in the Bighorn basin also.

In the correlation table given below only the Perissodactyla and two or three genera of other groups have been entered. This correlation, however, is based upon a study of the entire fauna. The tables of occurrence of the genera and species of the Lower Eocene mammals will be given in the articles on the various groups.

¹ The only recorded occurrence of *Meniscotherium* outside of the New Mexico Wasatch is that of a single specimen of *M. terrarubra*, the common species, from the Lost Cabin beds of the Wind River basin.

Correlation of Lower Eocene, Wyoming and New Mexico.

	New Mexico "Wasatch"	Evanston (typical Wasatch)	Wind R. Basin (typical Wind River)	Bighorn Basin "Wasatch"	Clark Fork Basin "Wasatch"
LOWER EOCENE			LOST CABIN (typical) <i>Hyrachyus</i> <i>Eotitanops</i> <i>Lambdotherium</i> <i>Heptodon</i> <i>Eohippus</i> <i>Meniscotherium</i>		
	LARGO (typical) <i>Eohippus</i> , <i>Meniscotherium</i> <i>Ambloctonus</i>			LOST CABIN <i>Lambdotherium</i> <i>Heptodon</i> <i>Eohippus</i> <i>Ambloctonus</i>	
	ALMAGRE (typical) <i>Eohippus</i> <i>Anacodon</i>	KNIGHT (typical) <i>Heptodon</i> <i>Eohippus</i>	LYSITE (typical) <i>Heptodon</i> <i>Eohippus</i>	LYSITE <i>Heptodon</i> <i>Eohippus</i> <i>Anacodon</i>	
				GRAY BULL (typical) <i>Systemodon</i> <i>Eohippus</i>	GRAY BULL <i>Systemodon</i> <i>Eohippus</i>
	[Unconformity between Wasatch (Almagre beds) and Torrejon]			SAND COULEE <i>Eohippus</i> etc.	SAND COULEE (typical) <i>Eohippus</i> (abundant) First Artiodactyls, Rodents & Primates
PALEOCENE				CLARK FORK No Perissodactyls etc.	CLARK FORK (typical) No Perissodactyls, Artiodactyls, Rodents or Primates
	TORREJON No Perissodactyls etc. Fauna more primitive than in Clark Fork			Fauna more advanced etc.	Fauna more advanced than in Torrejon

